

2009/SiC/15p ALUMINUM MMC

2009/SiC/15p Aluminum Metal-Matrix-Composite (Al MMC) is an ideal material for aerospace forgings. Its combination of enhanced strength and stiffness, and fatigue resistance 2x that of AA2024 and AA7075 cannot be matched by monolithic aluminum alloys.

TYPICAL AND MINIMUM MECHANICAL PROPERTIES

2009/SiC/15p-T4 Round Bar, 90-120mm (3.5-4.75in)		F, ty		F, tu		elong.
		MPa	ksi	MPa	ksi	%
Density= 2.84 g/cm ³ (0.1025 lb/in ³)						
Typical Properties	(LT)	352	51	510	74	7
	(L)	383	56	530	77	8.5
Minimum Properties	(LT)	330	47.9	450	65.3	3
	(L)	350	50.8	480	69.6	5

Notes:

- 1) Young's Modulus is typically 96 GPa (13.9 msi).
- 2) Typical Rockwell B scale hardness is 84-87.

Data is representative for 25mm (1 in) maximum section thickness during heat treatment. Mechanical properties will be dependent on the Al MMC material system, product form, geometry and heat treatment method.

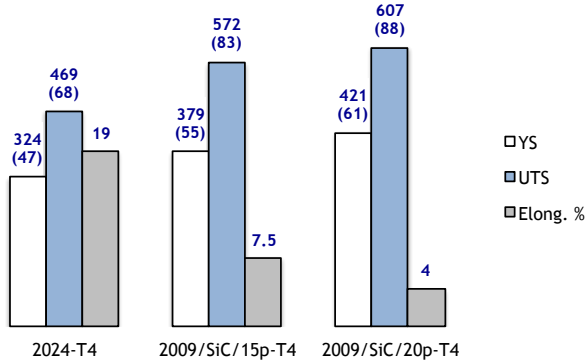
2009/SiC/15p is a powder metallurgy Al MMC comprised of AA2009 aluminum and 15 Vol% Silicon Carbide particles. It is available in vacuum-hot-pressed billet, extruded and forged product forms.

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ALUMINUM METAL-MATRIX-COMPOSITES: MORE THAN ALUMINUM

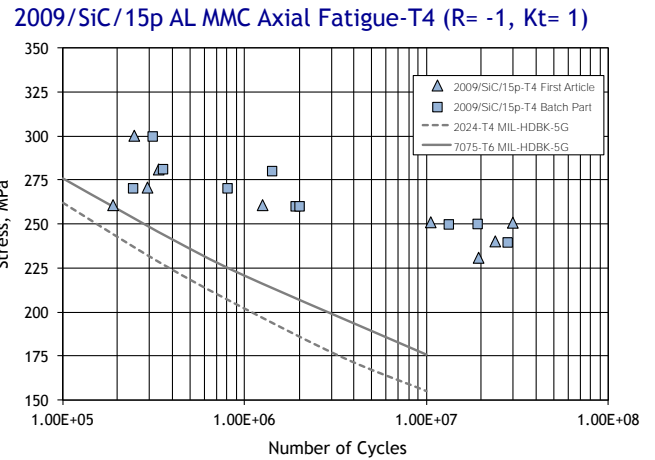
THE EXTREMELY LOW CTE OF THE SiC PARTICLES STRAINS THE ATOMIC LATTICE OF THE ALUMINUM MATRIX resulting in a dramatic increase in dislocation density. The combination of solid-state MMC processing and dislocation formation also results in a super-fine, coherent field of precipitates in the matrix. Ultimately, both the reinforcement and the precipitates limit the mobility of these dislocations leading to enhanced yield and ultimate tensile strength in the Al MMC. Further, it is important to note that there is a direct relationship between SiC content and Al MMC strength.

2009 Alloy Al MMC Strength, MPa (ksi)



2009 ALLOY MMC'S POSSESS ENHANCED DYNAMIC PROPERTIES SUCH AS IMPROVED FATIGUE AND CRACK GROWTH RESISTANCE as a direct result of the symbiotic relationship between the SiC reinforcing particles and the metal matrix. Together, the enhanced yield strength of the matrix and the presence of fine SiC particles retard crack growth initiation. Additionally, the presence of the fine SiC particles obstruct the path of the crack front and force the crack to follow a more tortuous path on a micro-scale. On a macro-scale, this tortuous path results in a slow progression of the overall crack front, which translates to improved fatigue resistance when compared with conventional, monolithic aluminum alloys.

DWA-USA Al MMCs also possess excellent fracture toughness. This is especially true for 2009/SiC/15p Al MMC forgings. Measured K_{IC} values range from 29-32 MPa \sqrt{m} (26-29 ksi \sqrt{in}).



AL MMCs ARE CONVENTIONALLY HEAT-TREATED. THE PRESENCE OF SiC PARTICLES IN THE ALUMINUM MATRIX ACCELERATES precipitation aging kinetics. Peak strength (T6) through artificial aging is achieved in approximately 8 hours, while natural aging (T4) can achieve peak strength after 96 hours.

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